DEVICE AND METHOD FOR CONTACTLESSLY DETERMINING A POSITION OF A PEDAL

[0001] This nonprovisional application is a continuation of International Application No. PCT/EP2020/061131, which was filed on Apr. 22, 2020, and which claims priority to German Patent Application No. 10 2019 112 572.3, which was filed in Germany on May 14, 2019, and which are both herein incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates a device and a method for contactlessly determining a position of a pedal, in particular in a vehicle, having at least a magnet and a sensor.

Description of the Background Art

[0003] Modern vehicles transmit the position signal of a pedal, for example of a brake pedal, through hydraulic lines to the brake cylinders. Systems are likewise known in which the position of the pedal is detected contactlessly and passed on to the brake system.

[0004] Contactless detection of the position can be accomplished through a position-indicating magnet and a position-determining sensor, for example a Hall sensor. In these cases, the magnet is arranged such that a motion of the pedal is converted into a motion of the magnet. The magnetic field produced by the magnet is detected by the sensor and processed.

[0005] The magnetic field is distinguished by a periodicity. As a result, unambiguous position determination is possible in only a limited range, and the maximum detectable positions of the magnet are limited.

[0006] A design of the magnet is required with which all positions can be detected continuously. This requires large magnets, resulting in increased costs.

[0007] Stringent requirements are placed on the functional safety of a vehicle brake system. For this reason, the determination of the position of a pedal for the purpose of braking demand must be extremely precise and reliable.

[0008] In order to ensure the functional safety requirements, position-determining sensors must be qualified and be resistant to interfering fields. If the requirements are not met, the system must be designed to be redundant, leading to increased component and circuit board costs.

SUMMARY OF THE INVENTION

[0009] It is therefore an object of the present invention to provide a device of the initially mentioned type such that the lack of unambiguity of the periodic magnetic field is not relevant and, at the same time, the size of the position-indicating magnet can be minimized to save costs.

[0010] This object is attained according to the invention by the means that a device for contactlessly determining a position of a pedal, in particular in a vehicle, has at least a magnet and a sensor, wherein the magnet produces a magnetic field that varies with the position of the pedal and that can be detected by means of the sensor, and the sensor has an output for providing at least one sensor signal, wherein the device has a processor, the processor has inputs for reading in the at least one sensor signal and outputs for outputting an output signal, a first and a second position range are defined, wherein each position range includes positions of the magnet with respect to the sensor, the processor generates an output signal from the at least one sensor signal, wherein the output signal takes on values that are unambiguously associated with a position of the magnet relative to the sensor in the first position range, and takes on a constant value that is independent of the position of the magnet relative to the sensor in the second position range.

[0011] A position determination for a pedal, in particular in a vehicle, is characterized in that only some of the possible positions of the magnet relative to the sensor in a first position range must be sensed continuously. In this range, it is important to know the position of the magnet exactly in order to transmit a braking demand to the brake system that corresponds to the position of the pedal.

[0012] Beyond a certain position, which should correspond to full braking, the exact position of the magnet relative to the sensor is unimportant. Instead, it is necessary to ensure that the braking demand to the brake system is high enough. A constant value as an output signal of a device according to the invention is sufficient for this purpose, since full braking produces the maximum possible braking action and cannot be increased further.

[0013] In order to be able to ascertain the position of the pedal, the possibility exists that the magnet is connected to the pedal through an element or is mounted on pedal. In this way, a motion of the pedal is converted into a motion of the magnet.

[0014] Since the sensor does not necessarily have to be in the vicinity of the pedal, the magnet can be connected to the pedal through a connecting rod, for example, and mounted in the vicinity of the sensor.

[0015] Permanent magnets that produce a magnetic field are usually used as magnets. It is absolutely possible to use other types of magnets as well. The advantage of a permanent magnet resides in its comparatively economical implementation.

[0016] Provision can be made that the sensor detects at least two spatial components of the magnetic field. In addition, provision can be made that a gradient can be determined from each of the at least two spatial components of the magnetic field by means of the sensor and can be provided at the output as sensor signals.

[0017] It is readily possible that the spatial components of the magnetic field detected by the sensor are first provided at the output as sensor signals and the calculation of the gradients takes place in the processor.

[0018] The gradients of the magnetic field can be used for position determination. The possibility exists in this case that a position signal can be calculated from the sensor signals by the processor.

[0019] Because the gradients of the magnetic field have a periodicity, a position determination can take place only within a delimited range. It is necessary to ensure that the lack of unambiguity of the signal does not lead to erroneous determination of the position.

[0020] For this reason, the possibility exists that a signal strength can be calculated from the sensor signals by the processor. The signal strength is calculated from the gradients using the formula signal strength=$\sqrt{\Delta B_x^2+\Delta B_z^2}$. B_x and B_z represent two spatial components of the magnetic field here.